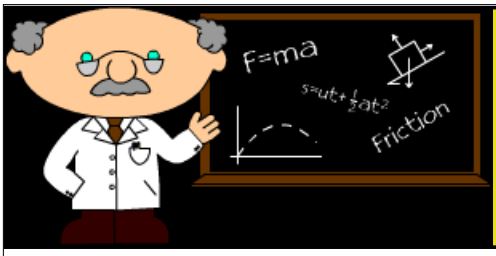
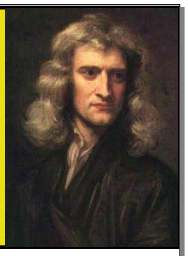


Unit 2: Dynamics



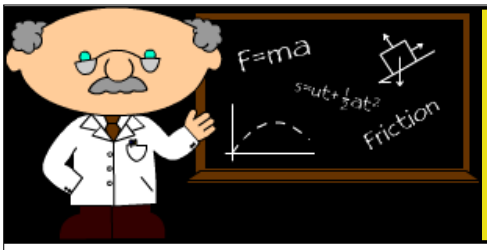
2.11 Gravitational Field Strength on Other Planets

$\vec{g}$ vs. G

Same letter; Big Difference

$\vec{g}$: - acceleration due to gravity/gravitational field strength
m/s²
- vector quantity
N/kg
- differs from place to place

G: - universal gravitational constant
- scalar quantity
- the same everywhere in the Universe
- 6.67×10^{-11} Nm^2/kg^2



While G is fixed throughout the Universe, $\vec{g}$ can change.

This is similar to the idea of mass (always fixed) and weight (variable).

We can use this idea to determine some Physics on different planets.

**Note: A helpful data table of planetary info is on Pg. 218.

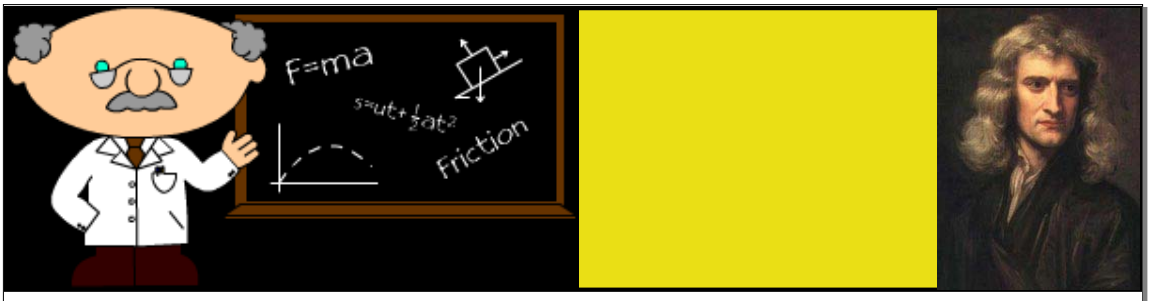
Ex.) How would you determine the weight of an object on another planet?

Step 1: Find the field strength on the planet, say Venus, from Pg. 218 in text.

$$g = \frac{GM}{r^2} = \frac{(6.67\times10^{-11})(4.87\times10^{24})}{(6.05\times10^{6})^2} = 8.87\ N/kg$$

Step 2: Use Newton's Second Law to work out the objects weight.

$$\vec{W} = \vec{F_g} = mg = 8.87\,m\ N \quad \left(\frac{N}{kg}\cdot kg\right)$$

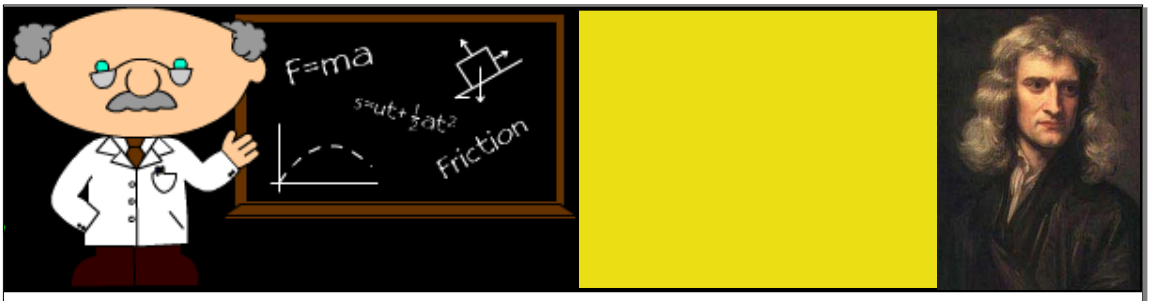


Ex.) What is the gravitational field strength on the planet Jupiter?

$$g = \frac{GM}{r^2} = \frac{(6.67\times10^{-11})(1.90\times10^{27})}{(7.15\times10^{7})^2} = 24.8\ N/kg$$

Ex.) What is the gravitational field strength on the planet Mercury?

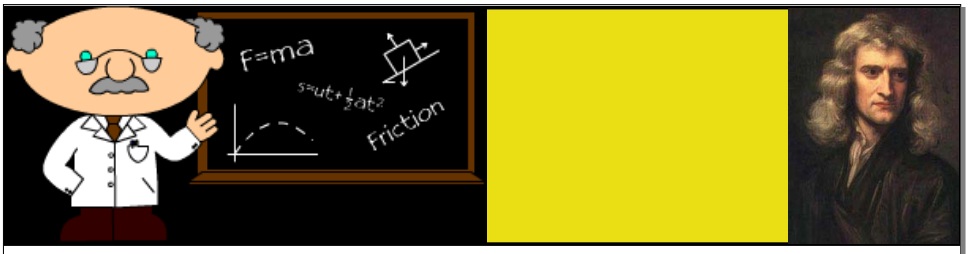
$$g = \frac{GM}{r^2} = \frac{(6.67\times10^{-11})(3.30\times10^{23})}{(2.44\times10^{6})^2} = 3.70\ N/kg$$



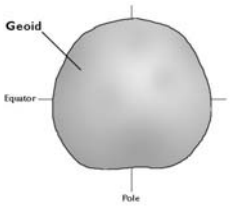
The field strength on Earth is also not fixed; it depends on two factors:

1. Altitude: How high above the surface of the Earth an object is placed.
2. Latitude: A measure of North and South of the equator.

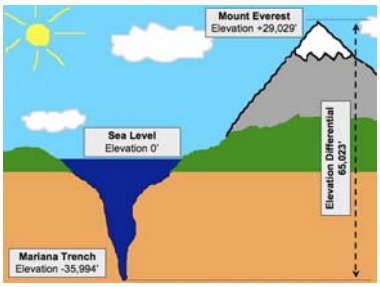
Why would latitude effect field strength?



Because of its rotation, Earth is not actually a perfect sphere. It is a geoid, slightly bulging around the equator.

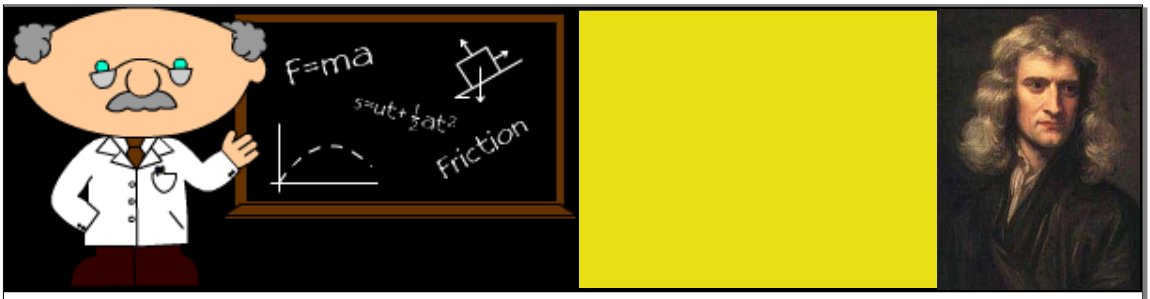


The Earth is about 21 km wider in radius at the equator than at the poles.



Of course, the Earth isn't perfectly smooth either: it has mountains and trenches.

But, compared to it's massive radius, these "imperfections" seem small.



Pg. 229 # 3, 5, 7.